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Next-Generation GaN Technology Doubles Power Density

EPC's 80-V, 4-mΩ EPC2619 GaN FET is the first product in a new generation of eGaN devices that have double the power density compared to the company's prior-generation products. This Gen 6 part has an $R_{DS(ON)}$ of just 4 mΩ in a tiny, 1.5-mm x 2.5-mm, footprint. The maximum $R_{DS(ON)}$ x area of the EPC2619 is 15 mΩ*mm^2, which is five times smaller than 80-V silicon MOSFETs (Fig. 1).

This product is designed for a range of motor drive applications such as 28-V to 48-V conversion for eBikes, eScooters and power tools. It's also suitable for use in high-density dc-dc converters, solar optimizers, and synchronous rectification at 12 V to 20 V in chargers, adaptors, and TV power supplies.

The EPC2619 also offers major improvement in another figure of merit (FOM), the typical $R_{DS(ON)}$ x Q_{GD}, which is indicative of power losses in hard-switching applications. With the EPC2619, this FOM is 10 times better than that of 80-V silicon MOSFETs, which enables switching frequencies that are 10 times higher than silicon MOSFETs and without an efficiency penalty, thus producing the highest power density says the vendor. This makes the EPC2619 well suited for high-frequency hard-switching 24-V to 48-V applications, such as used in buck, buck-boost, and boost converters.

The typical $R_{DS(ON)}$ x Q_{OSS}, which is indicative of power losses in soft-switching applications, is 87 mΩ*nC for the EPC2619—two times better than 80-V silicon MOSFETs. This makes the EPC2619 well suited for soft-switching applications, such as the primary rectification full bridge for LLC-based DCX (dc transformer) dc-dc converters.

"This is just the first product of a new generation of discrete transistors and integrated circuits for EPC. With the launch of the EPC2619, EPC continues to keep GaN power devices on a path reminiscent of Moore's Law," noted Alex Lidow, EPC CEO and co-founder.

However, as Lidow explains, the improved performance in EPC's Gen 6 GaN FETs comes not from a CMOS-like shrinking of transistor size versus Gen 5, but rather from improvement in device design and materials used in fabricating these GaN-on-silicon transistors. Known problem areas within the devices were addressed with advanced physics and supercomputer modeling, says Lidow.

The resulting Gen 6 devices can achieve the same $R_{DS(ON)}$ as Gen 5 devices in die that are half the size. As a result, an 80-V Gen 6 device outperforms a 100-V Gen 5 device that is double its size. The familiar chart of specific on-resistance versus breakdown voltage shows the improvement in performance achieved by Gen 6 devices versus Gen 5 and where this performance stands versus the silicon and GaN limits (Fig. 2).

The table below shows how performance compares across the generations for devices of similar die size, listing $R_{DS(ON)}$ and various figures of merit for the 80-V EPC2619 versus the 100-V EPC2204. This table also documents the improvements in FOMs cited above versus silicon, specifically typical $R_{DS(ON)}$ x Q_{OSS} and $R_{DS(ON)}$ x Q_{GD}.

The graph in Fig. 3 illustrates the impact of Gen 6's improved specifications on power stage performance, again comparing the similar sized 80-V EPC2619 and the 100-V EPC2204, but also the larger 100-V EPC 2218, another Gen 5 device. With a 6.825-mm^2 die, the EPC2218 is almost twice the size of the EPC2619, which has a 3.75 mm^2 die. Note that the unit cost per thousand of the new Gen 6 EPC 2619 at $1.70 is greater than the same-sized Gen 5 EPC2204 ($1.29, per Digi-Key), but less than the larger Gen 5 EPC2218 ($2.51 per Digi-Key).

The EPC90153 development board is a half bridge featuring the EPC2619 GaN FET. It is designed for an 80-V maximum device voltage and 30-A maximum output current. The purpose of this board is to simplify the evaluation process of power systems designers to speed their product's time to market. This 2-in. x 2-in. (50.8 mm x 50.8 mm) board is designed for optimal switching performance and contains all critical components for easy evaluation. The EPC90153 is priced at $200.00 each. For more information on the EPC2619 see the website. For more on the demo board see the EPC90153 page.

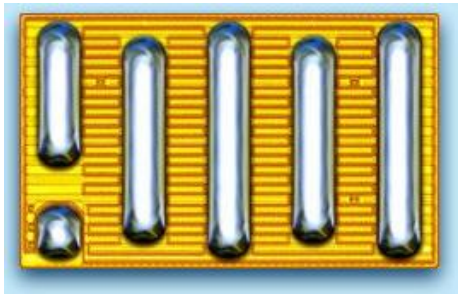

Fig. 1. The first of EPC's Gen 6 devices, the 80-V, 4-mΩ EPC2619 GaN FET in a 1.5-mm x 2.5-mm footprint offers higher performance than the company's Gen 5 devices and further widens the performance advantage of the company's GaN FETs versus traditional silicon MOSFETs. The improvements benefit high power density applications, including dc-dc conversion, motor drives, and synchronous rectification.

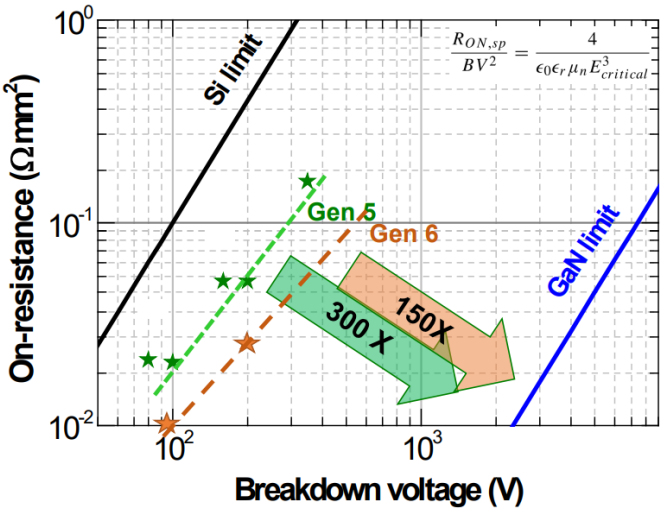

Fig. 2. Gen 6 is a factor of two smaller than Gen 5, as well as faster and more efficient. Compared with silicon MOSFETs, Gen 6 is 5x smaller and 30x faster, according to the vendor.

Table. Comparison of the Gen 6 EPC2619 versus the similarly sized Gen 5 and a comparable silicon MOSFET.

Parameter	BSZ070N08LS5 (at 10-V V_{GS})	EPC2204 (at 5-V V_{GS})	EPC2619 (at 5-V V_{GS})
Generation/product family	OptiMOS 5	Gen 5	Gen 6
VDS	80 V	100 V	80 V
RDS(ON) max	7 mΩ	6 mΩ	4 mΩ
RDS(ON) * area	88.5	16.5	12
RDS(ON) * QG	83	25	27
RDS(ON) * QOSS	171	110	87
RDS(ON) * QGD	29.5	3.5	3
RTJC to top	62°C/W	1°C/W	1°C/W
Package	3.3 x 3.3 mm PQFN	2.5 x 1.5-mm passivated die	2.5 x 1.5-mm passivated die
Device size	11 mm²	3.75 mm²	3.75 mm²
Device cost, unit price per 1000	$0.55 (per Infineon website)	$1.29 (per Digi-Key)	$1.70 (per press release)
Gate charge specs			
Q_G typ	14 nC	5.7 nC	8.3 nC
Q_{GD} typ	5 nC	0.8 nC	0.9 nC
Q_{OSS} typ	29 nC	25 nC	27 nC
Q_{RR} typ.	27 nC	0 nC	0 nC

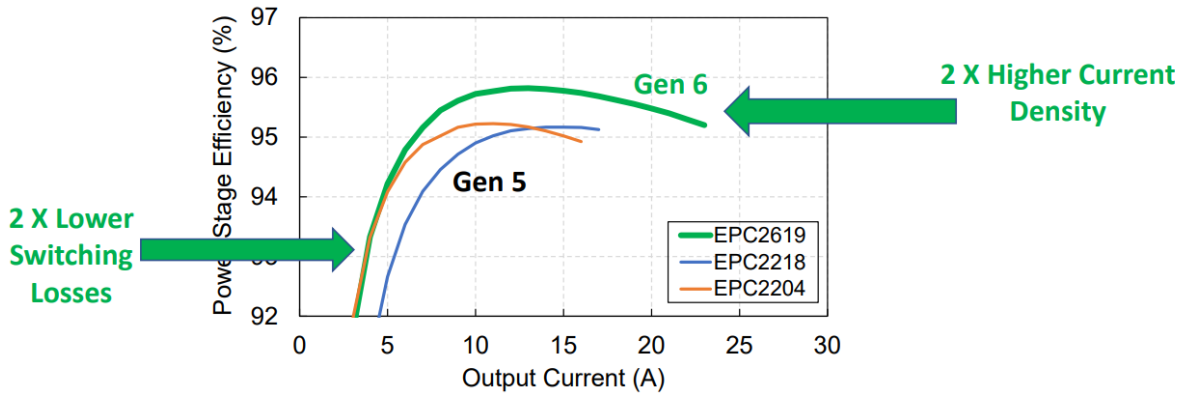

Fig. 3. The Gen 6 EPC2619 achieves lower switching losses and higher current density than two Gen 5 GaN FETs—one the same size (EPC2204), and another that's nearly twice the size (EPC2218).